Connecting the dots
toward a resource efficient cannabis future.
We advance resource efficiency to create a better cannabis future

- Founded 2016 in Portland, OR
- Stakeholder-driven non-profit
- Market transformation
- Board includes:
  - ACEEE
  - California Cannabis Industry Assn.
  - Former USGBC board member
  - Former Energy Policy Advisor to two Oregon governors
- Funded by governments, utilities, foundations & industry leaders
THE 2018 CANNABIS ENERGY REPORT

By 2020, legal and illicit cannabis production will produce more than 2.6 million tons of electricity-based CO₂ emissions.
Benchmarks: kWh/square foot of flowering canopy

- Indoor: 262.05 kWh
- Greenhouse/Hybrid/Mixed Light: 133.72 kWh
- Outdoor: 2.36 kWh
Benchmarks: grams/kWh

- Indoor: 0.79 grams
- Greenhouse/Hybrid/Mixed Light: 1.07 grams
- Outdoor: 14.37 grams
Vision: Cannabis is the incubation platform for our agricultural future

CARBON-POSITIVE OUTDOOR FARMS
- Carbon sequestration
- Diesel generator replacement
- Solar & storage
- Net zero energy

HYPER-EFFICIENT CONTROLLED ENVIRONMENTS
- LED lighting
- Vertical stacking
- Automation
- Mixed light
Critical challenges to market transformation

- Lack of data + culture of secrecy
  - No documented best practices
- No existing policies or codes
  - To be applied to horticultural production facilities
- Inconsistent engagement by utilities and governments
  - Because of Federal concerns
Three areas of focus:

To accelerate **energy-efficient, low-carbon** cannabis cultivation

1. Data
2. Policy
3. Education
Aggregating data to point the way

- Sets performance benchmarks - at site and aggregate levels
- Informs standards, policies, utility incentives, manufacturer R&D
- Assesses cultivation methods by climate and grow environment
- Validates technologies and techniques

<table>
<thead>
<tr>
<th>Lighting Type (Indoor)</th>
<th>HPS</th>
<th>LED</th>
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</thead>
<tbody>
<tr>
<td><strong>Average Electricity Productivity (grams/kWh)</strong></td>
<td>0.6</td>
<td>1.4</td>
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*CannabisPowerScore.org*
Case studies

Production Efficiency: 17%

Facility Efficiency: 13%

HVAC Efficiency: 58%

Lighting Efficiency: 20%

Location:
Denver County, CO

Cultivation Method:
Indoor Facility

Techniques & Technologies:
- HID in mom, veg and flowering rooms
- Conventional HVAC with standalone dehumidifiers

Production Efficiency: 0.154 grams / kWh

Facility Efficiency: 514 kWh/ft² of flower canopy

HVAC Efficiency: 115 kWh/ft² of flower canopy

Lighting Efficiency: 71.5 W/ft² of flower canopy

24th Percentile of Indoor Farms
### Case studies

![Cannabis PowerScore Logo](image)

**Location:**
King County, WA

**Cultivation Method:**
Indoor Facility

**Techniques & Technologies:**
- LEDs in vegetative and flowering
- Vertical stacking and building automation

<table>
<thead>
<tr>
<th>Metric</th>
<th>Efficiency</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Production Efficiency</td>
<td>58%</td>
<td>1.35 grams / kWh</td>
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<tr>
<td>Facility Efficiency</td>
<td>83%</td>
<td>243 kWh/ft² of flower canopy</td>
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<tr>
<td>HVAC Efficiency</td>
<td>100%</td>
<td>65 kWh/ft² of flower canopy</td>
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<tr>
<td>Lighting Efficiency</td>
<td>92%</td>
<td>36 W/ft² of flower canopy</td>
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Advancing Policy to drive efficiency

Template built off Massachusetts model:

- Stakeholder engagement
- Lighting Power Density and Photon Efficacy
  - DesignLights Consortium (DLC)
- Ongoing data collection
  - Increasingly stringent targets over time
- Exemptions for renewables
- Incentives, education, innovation
Educating the market to accelerate adoption

- Peer-reviewed reports
- Grower-targeted best practices events
- Multi-stakeholder events (e.g., Indoor Ag Summit)
- Utility program design/implementation, grower outreach, PowerScore tie-in, DLC/prescriptive incentive coordination

Coming soon:
Best Practices Guides:

> Cultivating with LED Lighting
> Efficient HVAC in Cultivation Operations
Right-size your Cost-per-Gram:
Retrofit strategies to compete through efficiency
Recommended research/support

IMMEDIATE
● Data, baseline studies & trend analysis
● Best practices on efficiency and renewables
● Standard development
● Technology demonstrations
● Grower engagement on efficiency at hookup

STRATEGIC
● Code adaptation to controlled environment agriculture
● Risk of stranded assets as production shifts with emerging global markets
● Knowledge transfer to other CEA sectors / crops
● Banking/financing
● Carbon sequestration valuation of regenerative practices (start with hemp)
Thank you!

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